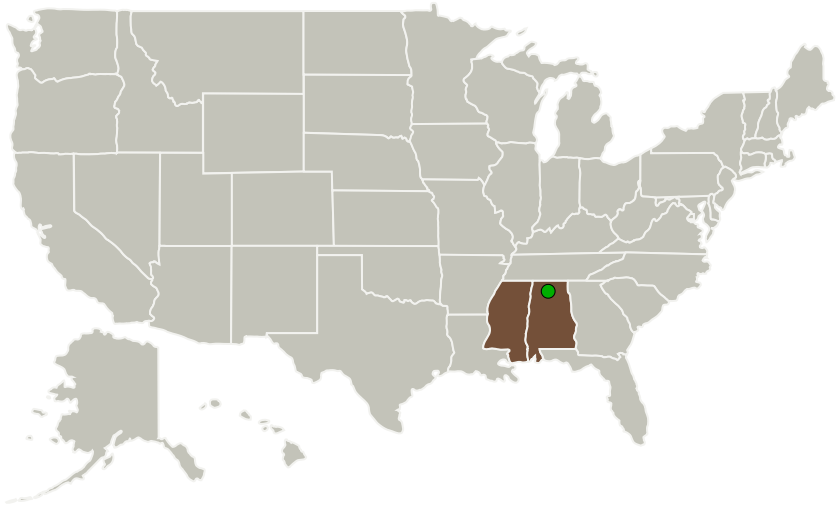
Prediction of Strutural Response and Fluid-Induced Vibration in Turbomachinery, Phase I

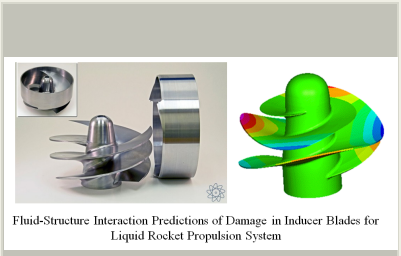
Completed Technology Project (2016 - 2017)

Project Introduction

Advanced turbomachinery components play a critical role in launch vehicle and spacecraft liquid rocket propulsion systems. To achieve desired efficiencies, extremely tight tolerances are often imposed between inducer blades and shrouds or other system components which sets up strong interactions that influence both the aerodynamics and the structural performance of blades and vanes. These transient interactions, including rotor-stator interactions (RSI), can deform the blades and significantly impact the vibrational and acoustic characteristics of the engine, greatly reduce the efficiency, and even lead to blade or vane failure. Current production design tools for turbomachinery do not account for the coupled fluid-structure interaction (FSI) physics associated with these phenomena. This STTR effort will develop and deliver a multidisciplinary design tool for advanced turbomachinery components to account for FSI phenomena and enable more accurate modeling of systems and subscale demonstrators. CFDRC will supplement the NASA massively parallel Loci framework with highly accurate and efficient integrated FSI capabilities to enable better understanding of critical turbomachinery problems in liquid rocket propulsion systems that defy conventional predictions. Loci will be enhanced to enable constrained deformations in moving overset grid systems to support prediction of structural response and fluid-induced vibration in rotating components. Phase I will demonstrate improved modeling fidelity and provide great insight into FSI phenomena in turbomachinery, and Phase II will bring the complete predictive capabilities to production for detailed investigations into advanced turbomachinery for liquid rocket propulsion systems.

Primary U.S. Work Locations and Key Partners





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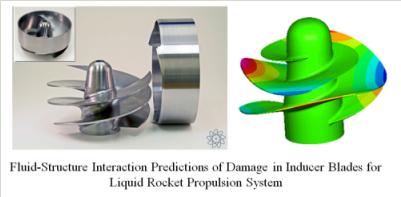
Completed Technology Project (2016 - 2017)

Organizations Performing Work	Role	Type	Location
CFD Research Corporation	Lead Organization	Industry	Huntsville, Alabama
Marshall Space Flight Center(MSFC)	Supporting Organization	NASA Center	Huntsville, Alabama

Primary U.S. Work Locations	
Alabama	Mississippi

Images



Briefing Chart Image
Prediction of Strutural Response and Fluid-Induced Vibration in Turbomachinery, Phase I *(https://techport.nasa.gov/image/126864)*

Organizational Responsibility

Responsible Mission Directorate:
Space Technology Mission Directorate (STMD)

Lead Organization:
CFD Research Corporation

Responsible Program:
Small Business Innovation Research/Small Business Tech Transfer

Project Management

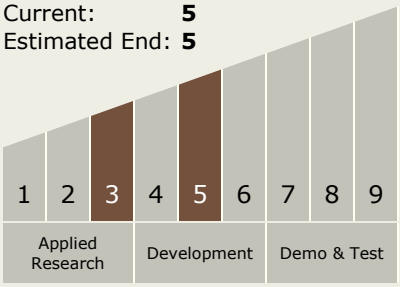
Program Director:
Jason L Kessler

Program Manager:
Carlos Torrez

Principal Investigator:
Robert E Harris

Technology Maturity (TRL)

Start: **3**
Current: **5**
Estimated End: **5**



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Completed Technology Project (2016 - 2017)

Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
  - TX12.5 Structural Dynamics
    - TX12.5.1 Loads and Vibration

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System